

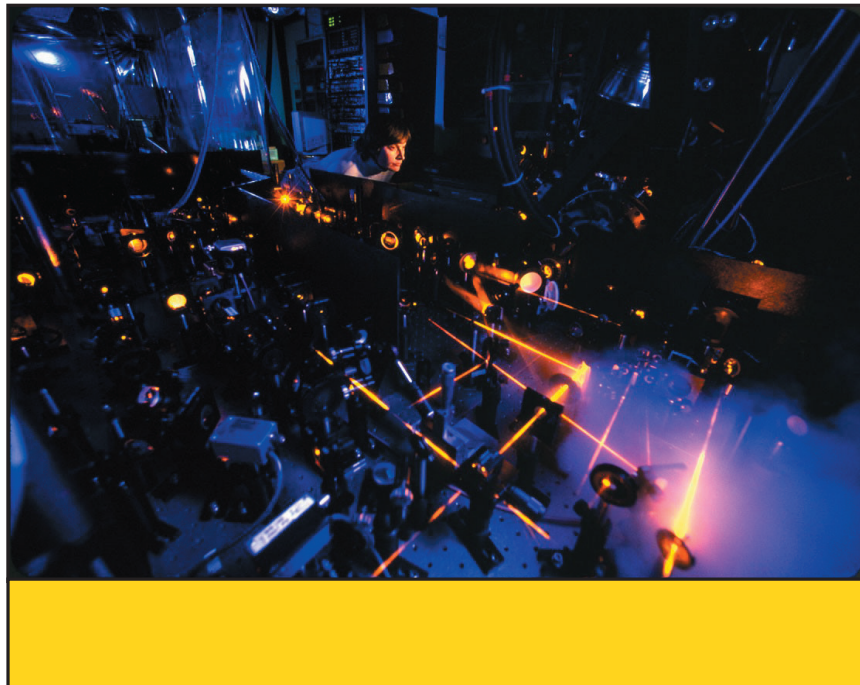


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Science and Technology for Tomorrow's Aerospace Forces

Success Story

FREEZING LIGHT IN ITS TRACKS



Stopping light and releasing it without losing any of its original characteristics could be the breakthrough for a new generation of computers called quantum computers. “Quantum” refers to discrete changes in the energy or phase of atomic levels. These computers may solve problems completely inaccessible to today’s computers.

Another field to benefit from this breakthrough is nonlinear optics with applications from telecommunications to imaging, which could be useful in designing ultra-sensitive optical switches. Other practical uses include new ways to communicate solely by light and coding methods to protect both military and personal information.



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Accomplishment

In 2000, the Air Force Office of Scientific Research (AFOSR) began sponsoring Dr. Lene Hau's research. By using a cluster of cooled atoms, Dr. Hau and her team of researchers stopped light in its tracks. A second laser beam converted the frozen pulse back into a moving light pulse, but significantly with all of its original properties. This allows the researchers to control a light pulse by capturing and storing it, thus enabling them to release it at will. She and her colleagues "...believe that this system could be used for quantum information transfer, ...and with use of photon-to-atom interactions, quantum information processing may be possible during the storage time."

Continuing under AFOSR sponsorship, Dr. Hau and her group are currently continuing their research into optical information storage in an atomic medium using halted light pulses.

Background

Sponsored by AFOSR, Dr. Hau, a Gordon McKay Professor of Applied Physics and professor of physics at Harvard University in Cambridge, Massachusetts, first slowed a light pulse down to a leisurely 38 miles per hour and eventually stopped it completely. Researchers accomplished this by creating a small cigar-shaped cloud of sodium atoms trapped in a magnetic field and cooled to a temperature within a millionth to a billionth of a degree of -459.7°F, referred to as absolute zero. Absolute zero is the temperature at which atoms have the lowest amount of energy.

Next researchers illuminated the cloud with a carefully tuned laser beam that altered the optical properties and then sent another light pulse into the cloud. This combination of laser beams, magnetic fields, and radio waves cooled the sodium atoms.

Using a similar technique to completely stop the pulses, a laser beam can convert the frozen pulse back into a moving light pulse, but significantly with all of its original properties. This allows researchers to control a light pulse by capturing and storing it, thus enabling them to release it at will.

Additional information

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTC, (800) 203-6451 and you will be directed to the appropriate laboratory expert. (02-OSR-03)